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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/787,062	06/28/2001	Markku Leskela	SEPP9.001APC	1371

20995 7590 08/23/2004

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EXAMINER

ANDERSON, MATTHEW A

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 08/23/2004

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/787,062
Filing Date: June 28, 2001
Appellant(s): LESKELA ET AL.

Andrew N. Merickel
For Appellant

EXAMINER'S ANSWER

MAILED
AUG 23 2004
GROUP 1700

This is in response to the appeal brief filed 7/06/2004.

(1) *Real Party in Interest*

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) *Status of Claims*

The statement of the status of the claims contained in the brief is correct.

(4) *Status of Amendments After Final*

No amendment after final has been filed.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

The rejection of claims 1-39 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

5,972,430	<i>DiMeo Jr. et al.</i>	10-1999
5453494	<i>Kirlin et al.</i>	9-1995
6,020,024	<i>Maiti et al.</i>	2-2000

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo Jr. et al. (US 5,972,430) in view of Kirlin et al. (US 5,453,494) and Maiti et al. (US 6,020,024).

DiMeo discloses a CVD method for forming multi-component oxide layers. From Fig. 2 is clear that this method is a pulsed method of feeding the reactants into the reactor and then oxidizing them with iterations until the final thickness is deposited. The CVD method is described as an equivalent variant to the related ALE (atomic layer

epitaxy) method. The multi-component oxides are described in col. 7 as including BST (barium strontium titanate). The examiner notes that the disclosure of Kirlin et al is incorporated in full into that of DiMeo Jr. et al's. (col. 8 line 53) to describe the chemical Ba and Sr precursors of use. In example 1 in col. 11 is the disclosure of using Si substrates for the growth of BST. In col. 7 lines 1-30 the substrate can be any employed in thin film processing. Oxidants include, according to col. 9 lines 1-15, oxygen, ozone, nitrous oxide, nitric oxide, nitrogen dioxide, water vapor, hydrogen peroxide vapor, and mixtures thereof. Plasma activation of the precursors is suggested.

DiMeo et al. does not explicitly suggest using at least one cyclopentadienyl compound of strontium and/or barium in their deposition process as claimed.

Kirlin et al. discloses metal complexes of use in metal-organic CVD (MOCVD). The source reagents of Kirlin have a general formula of MA_yX as described in the abstract. M is a metal such as Ba or Sr. A is a monodentate or multidentate organic ligand, y is a 2 or 3, X is a monodentate or multidentate ligand coordinated to M and containing one or more atoms independently selected from C, N, H, S, O, and F. The ligand A may be selected from the beta-diketones, cyclopentadienyls, alkyls, perfluoroalkyls, alkoxides, perfluoroalkoxides, and Schiff bases. This is more thoroughly explained in col. 4 lines 55+, col. 5 lines 1-62, and col. 8 lines 57+ col. 9 and col. 10 lines 1-20. In col. 8 lines 15-57 the temperature for convenient flow of the precursors of Kirlin is given as less than 200°C and their decomposition is given as over 400°C. This is given as important to reduce premature decomposition in the piping. In col. 43, the precursor gas $Ti(OP)_4$ is suggested for $BaTiO_3$ deposition.

Maiti et al. Maiti et al. discloses the annealing of BST to fully oxidize the metal oxide while preventing adverse oxidation of the substrate. (col. 4 lines 15-30) Maiti et al suggests the deposition of BST, St or BT by the various CVD methods and or nanolaminate processing. Nanolaminate processing is described as atomic layer deposition of metals serially in time and allows for composite oxides (i.e. BST) to be formed which comprise one or more metallic oxide materials.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the above references because DiMeo et al. incorporates Kirilin fully by reference and Maiti et al. discloses methods of using atomic layer CVD to form BST composite oxide. Motivation for the combination stems from Maiti which states BST can be deposited in several ways and the combination would expand process flexibility.

In respect to claims 1,6, 7, 27, 28-36, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow by an atomic layer pulse process an oxide thin film on a Si substrate using the claimed precursor compounds of claim 1 because DiMeo et al. combined with Maiti et al. suggests such an atomic layer CVD process for forming BST and Ti isopropoxide (a known alkoxides; see col. 12 lines 1-10), and Kirilin et al. suggests the using of cyclopentadienyl compounds of Ba and or Sr and reactive oxygen precursors such as ozone or oxygen.

In respect to claims 1,6, 7, 27, 28-36 it would have further been obvious to one of ordinary skill in the art at the time of the present invention to alternately flow the listed reactants and purge with an inert gas to provide self-limited surface reaction because

Maiti et al. discloses that such CVD can have the individual reactants flowed in to form atomic layers (i.e. self-limited thickness) and DiMeo discloses the pulsed CVD using the required precursors.

In respect to claims 2, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow dielectric films such as BST or BT (barium titanate) because both are disclosed in both references.

Claim 3 would have been obvious to one of ordinary skill in the art at the time of the present invention because of Fig. 2 of DiMeo Jr. et al.

In respect to claims 20, 37, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the thickness obtained because Fig.2 of DiMeo directly suggests this and such optimization would have been achieved with only routine experimentation.

In respect to claims 4, 38-39, it would have been obvious to optimize the process parameters including the concentrations of the precursors because of the stoichiometry of the desired Ba or Sr containing titanate compound.

In respect to claim 5, 8-13, 21, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use the described cyclopentadienyl because the described M_AY_X of Kirlin et al. suggests the M(Cp)₂ or M(Cp)₂Ln as described in the claims. The bonding of the cyclopentadienyls would also have been expected since Kirlin discloses precursors made up of two or three cyclopentadienyls which are mono or multi dentate and X is disclosed as having one or more of the atoms from the group C,N, H,S, and F.

In respect to claims 14-18, 22-24, it would have been obvious to one of ordinary skill in the art at the time of the present invention that amino, alkyls, hydrocarbons, amines, polyamines, bipyridines, and other ligands be incorporated into the cyclopentadienyls precursors because such ligands are disclosed by Kirlin et al.

In respect to claim 19, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the film deposition temperature because such is suggested by Kirlin et al. and such optimization would have been achieved with only routine experimentation.

In respect to claims 25 and 26, it would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the anneal of Maiti et al. with DiMeo et al because then one of ordinary skill would be assured of full oxidation of the metal oxide while avoiding substrate corrosion.

Further, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the temperature of the annealing because annealing is nothing more than the application of heat under certain conditions and such optimization would have been achieved with only routine experimentation.

(11) Response to Argument

The argument entitled "First Factual Error" is not persuasive. The ALE and CVD are described as variants by DiMeo et al. which achieve the result of forming multi-

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component oxide thin film layers. The rejection of claims is actually based on the combination of DiMeo et al., Kirlin et al. and Maiti et al. as stated in the office action.

The argument entitled "Second factual error" is also not convincing.

The cited prior art discloses the growth of thin films on a surface by reaction of precursors on that surface. This least suggests that the surface was saturated with the precursor before the thin film forming reactions occurred.

The argument that the process is not taught by the references is not convincing. DiMeo et al col. 1 lines 43-60 discloses that ALE is a form of CVD deposition useful for multi-component oxide deposition. In addition, the combination of references above discloses purging between growth steps in an atomic layer CVD deposition process indicating to the ordinarily skill artisan a limited process. Maiti et al. discloses an atomic layer CVD for metal oxide growth in col. 3 lines 55-65. DiMeo et al. also describes the process cycles in col. 10 lines 30-40 to be at least 5 where about 4 angstroms of material are deposited each cycle. Also, DiMeo et al. explicitly suggests using Kirlin's precursors (see col. 8 lines 50-55 of DiMeo et al.) which, as per the abstract of Kirlin, include cyclopentadienyls.

The argument that the process of DiMeo is not ALE is not convincing. The examiner notes that Maiti et al. suggests using CVD processing to form atomic layer depositions of BST oxides . Also, DiMeo teaches about 5 angstrom thick layers which in turn suggest an atomic layer process to those of ordinary skill.

The appellant's argument based on the Bedair article is not convincing. The applicant chooses to ignore the DiMeo reference which clearly describes the process as

consisting of purge steps between the deposition of the precursor and the oxidation of the precursor. The examiner notes that typical CVD does not have the purge steps required by DiMeo's digital CVD process. DiMeo suggests using the same cyclopentadienyls precursors as presently claimed. One of ordinary skill would expect the same limited adhesion of these precursors to the substrate. DiMeo's purge steps, which remove excess precursor from the reactor, further point toward a limited process.

The argument that DiMeo et al. somehow teaches away is not persuasive. The appellant seems to argue that the flow rate of precursors into the chamber is unimportant in ALE processing. Additionally, the examiner points out that the precursors themselves suggested by DiMeo et al. and the present invention overlap and one of ordinary skill would expect them to act in a similar manner.

The argument that self-limiting and saturating surface reactions merit allowability for the present invention is not convincing. The examiner notes that DiMeo et al. uses the same precursors. The precursors are flowed into the reactor in both cases. The reactors are purged in both cases. The precursors are oxidized in both cases. BST can be formed in both cases. DiMeo et al. discloses atomic layer thicknesses formed by the growth process (see above). The examiner does not agree with the appellant's seeming argument that since these words do not appear in the references, the claims are allowable.

The argument that if one embodiment of DiMeo et al. teaches multiple monolayers of growth per cycle then the claims are allowable is not convincing. The examiner has cited above another instance in DiMeo where monolayer thicknesses are

suggested. Regardless, the rejection is based on the combination with Maiti et al. which suggests the atomic layer growth with CVD processes.

The argument that there was no suggestion to combine is not convincing. ALE (a method related to CVD according to DiMeo) was suggested by DiMeo et al. of capable of producing limited atomic layers of oxides. DiMeo's process is described as useful for the task of depositing an oxide layer. This is sufficient evidence that ALE and the CVD of DiMeo are at least equivalents. Regardless, the process of DiMeo in light of Maiti et al. suggests the claimed steps and thus renders it obvious.

The argument that there is not reasonable expectation of success is not persuasive. DiMeo et al. has a definite example of atomic layer thicknesses of oxide being grown by their method. One of ordinary skill would expect to be able to replicate this success.

The argument against obviousness is not convincing for the reasons set forth above.

The concluding arguments are not convincing as explained above.

For the above reasons, it is believed that the rejections should be sustained.

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Respectfully submitted,

MAA


August 19, 2004


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